

## **2.3    *Electrical/Power Support Systems***

### **2.3.1    Electrical Design**

The electrical interfaces for plate mount and canister customers differ slightly. Figure 2.34 and Table 2.4 give plate mounting details. Figure 2.35, 2.36, and Table 2.5 provide details on the canister mount. Figure 2.36 shows the Motorized Door Canister with the control and monitoring interface. Electrical designs interfaces are governed by ICD-2-19001. The electrical characteristics of the thermistors is defined in Section 2.2.6.

### **2.3.2    Power Characteristics**

Each of the two 12 gauge 28V power lines is protected by a 20A fuse (vacuum derated to 10A), per figure 2.37. Customers must provide consistent wiring and fusing within their payloads. Smaller gauge wire for power service shall require an appropriately down-sized fuse to provide circuit protection. Table 2.6 shows acceptable wire and fuse sizes.

## Hitchhiker Standard Interface Cables (Plate Mounted Customer)

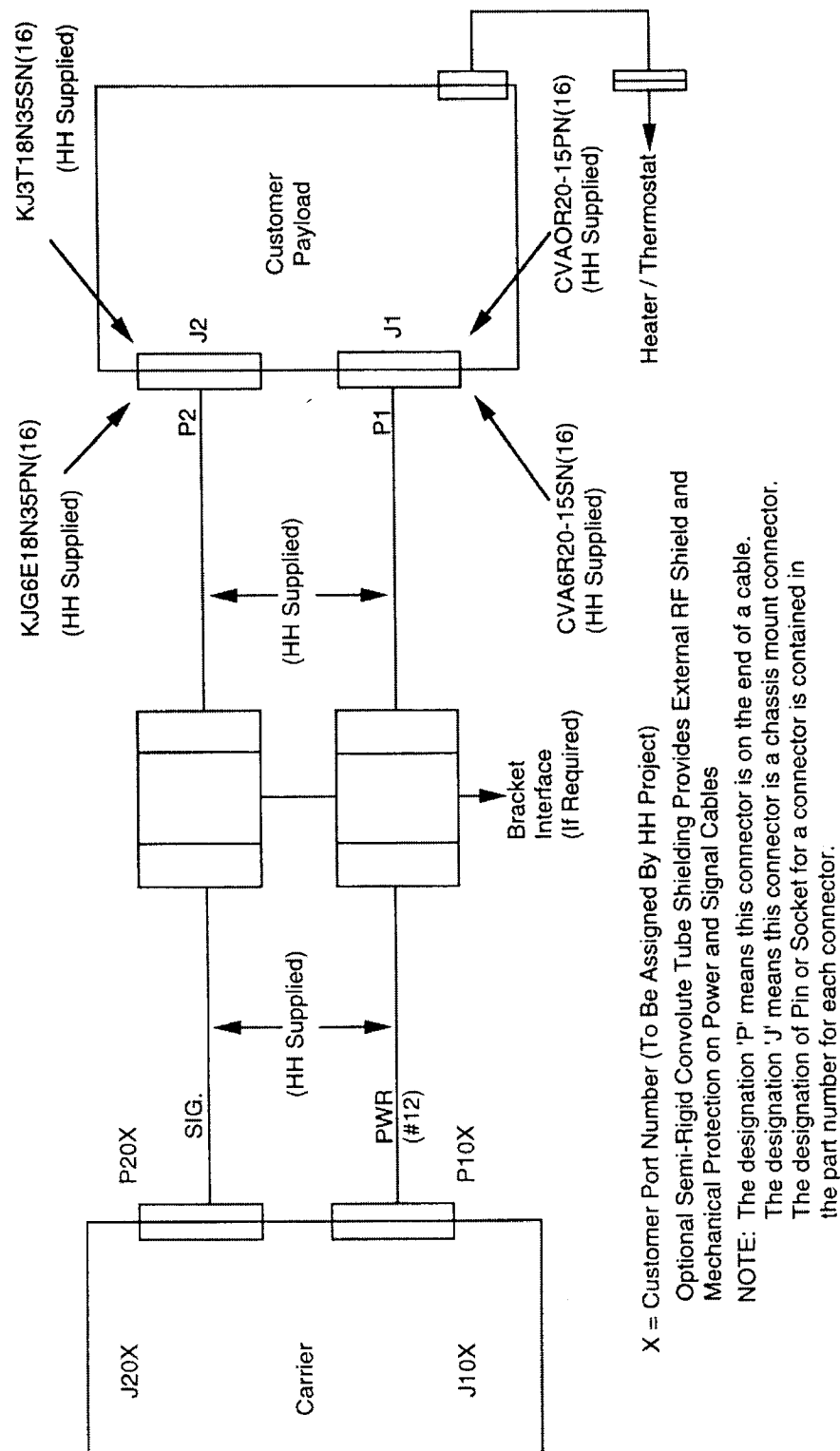


FIGURE 2.34 HITCHHIKER STANDARD INTERFACE CABLES

TABLE 2.4 PLATE ELECTRICAL INTERFACE CONNECTORS

| <b><u>ID</u></b>                            | <b><u>PIN (Note 3)</u></b> | <b><u>Type (Note 2)</u></b> | <b><u>Function</u></b>                 |
|---|----------------------------|-----------------------------|--|
| <b><u>Power Connector J1: (Note 4)</u></b>  |                            |                             |  |
| +28A  | A                          | C                           | +28V Power Circuit A                   |
| RETA  | B                          | C                           | Power Return (Note 1)                  |
| +28B  | C                          | C                           | +28V Power Circuit B                   |
| RETB  | D                          | C                           | Power Return (Note 1)                  |
| +28HTR                                      | E                          | B                           | +28V Heater Power                      |
| RETH  | F                          | B                           | Heater Power Return (Note 1)           |
| FRMGND                                      | G                          | B                           | Frame Ground                           |
| <b><u>Signal Connector J2: (Note 4)</u></b> |                            |                             |  |
| PCMAD                                       | 1                          | A                           | PCM Analog Data                        |
| PCMINDX                                     | 41                         | A                           | PCM Index Pulse                        |
| SIGGND                                      | 2                          | A                           | Signal Ground                          |
| PCMCLK                                      | 42                         | A                           | PCM Bit Rate Clock (Note 5)            |
| PCMENA                                      | 32                         | A                           | Serial Digital Enable A (Note 5)       |
| PCMENB                                      | 33                         | A                           | Serial Digital Enable B (Note 5)       |
| PCMDATA                                     | 3                          | A                           | Serial Digital Data A (Note 5)         |
| PCMDATB                                     | 8                          | A                           | Serial Digital Data B (Note 5)         |
| THER1                                       | 14                         | A                           | Thermistor 1                           |
| THER2                                       | 15                         | A                           | Thermistor 2                           |
| THER3                                       | 16                         | A                           | Thermistor 3                           |
| SHIELD                                      | 6                          | A                           | Shield For Command And<br>Data Signals |
| RD+   | 21                         | A                           | Receive Data Async + From SPOC         |
| RD-   | 22                         | A                           | Receive Data Async - From SPOC         |
| SD+   | 23                         | A                           | Send Data Async + To SPOC              |
| SD-   | 24                         | A                           | Send Data Async - To SPOC              |
| BLCMD1                                      | 17                         | A                           | Bi-Level/Pulse Command 1               |
| BLCMD2                                      | 18                         | A                           | Bi-Level/Pulse Command 2               |
| BLCMD3                                      | 19                         | A                           | Bi-Level/Pulse Command 3               |
| BLCMD4                                      | 20                         | A                           | Bi-Level/Pulse Command 4               |
| SCMDCLK                                     | 10                         | A                           | Serial Command Clock (Note 5)          |
| SCMDENV                                     | 11                         | A                           | Serial Command Envelope (Note 5)       |
| SCMDDAT                                     | 12                         | A                           | Serial Command Data (Note 5)           |
| METMIN                                      | 40                         | A                           | MET/MET One Minute Pulse               |
| IRIGMET+                                    | 30                         | A                           | IRIG-B MET (MET) +                     |
| IRIGMET-                                    | 31                         | A                           | IRIG-B MET (MET) -                     |
| FRMGND                                      | 49                         | A                           | Frame Ground                           |
| KUMRCLK+                                    | 34                         | A                           | Customer Generated MR Clock +          |
| KUMRCLK-                                    | 35                         | A                           | MR Clock -                             |

| <b><u>ID</u></b> | <b><u>Pin (Note 3)</u></b> | <b><u>Type (Note 2)</u></b> | <b><u>Function</u></b>                 |
|------------------|----------------------------|-----------------------------|--|
| KUMRDAT+         | 43                         | A                           | Customer Generated MR Data +           |
| KUMRDAT-         | 44                         | A                           | MR Data -                              |
| KUMRSHLD         | 25                         | A                           | Shield For KU Signals                  |
| UNDTSP1+         | 61                         | D                           | Undedicated TSP 1 + (Optional Video +) |
| UNDTSP1-         | 66                         | D                           | Undedicated TSP 1 - (Optional Video -) |
| UNDTSPS1         | 54                         | A                           | Shield For Undedicated TSP 1           |
| UNDTSP2+         | 62                         | D                           | Undedicated TSP 2 +                    |
| UNDTSP2-         | 63                         | D                           | Undedicated TSP 2 -                    |
| UNDTSPS2         | 55                         | A                           | Shield For Undedicated TSP 2           |
| UNDTSP3+         | 56                         | D                           | Undedicated TSP 3 +                    |
| UNDTSP3-         | 57                         | D                           | Undedicated TSP 3 -                    |
| UNDTSPS3         | 48                         | A                           | Shield For UNDTSP3                     |
| UND4             | 58                         | A                           | Undedicated 4                          |
| UND5             | 59                         | A                           | Undedicated 5                          |
| UND6             | 60                         | A                           | Undedicated 6                          |
| UND7             | 64                         | A                           | Undedicated 7                          |
| UND8             | 65                         | A                           | Undedicated 8                          |
| UNDS             | 53                         | A                           | Shield For Undedicated 4-8             |
| MDAOC            | 52                         | A                           | Reserved                               |
| MDASTP           | 51                         | A                           | Reserved                               |

Note 1: Power Return Pins B, D And F May Be Connected Together Within Payload.

Note 2: Wire Type Designations:

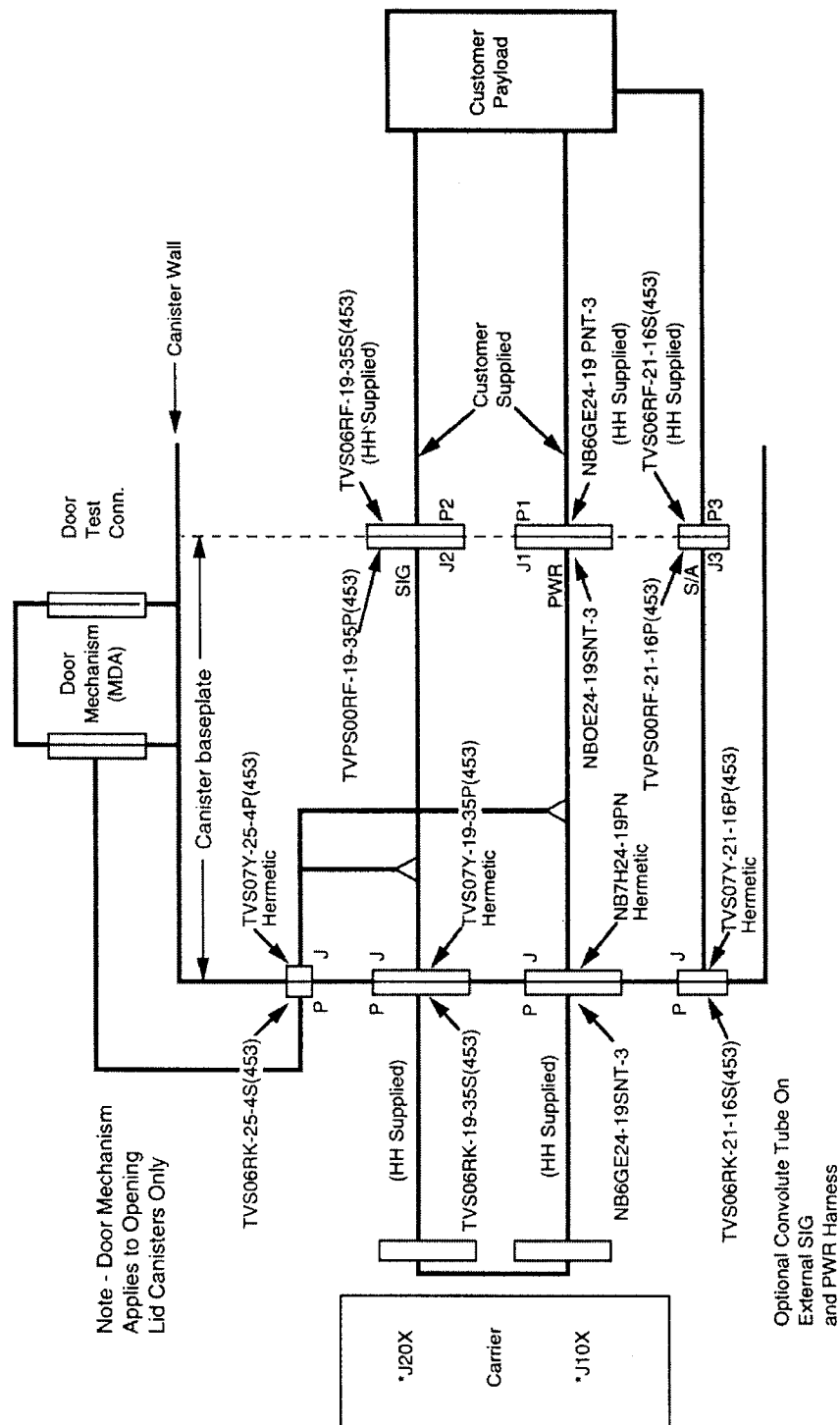
A 22 GA  
B 16 GA  
C 12 GA  
D 26 GA

Note 3: Customer Will Make No Connections To Unused Pins

Note 4: The Designations "J1" And "J2" In This Table Indicate The Pin Out For A Chassis Mount Connector Mounted To A Particular Scientific Experiment. The Hh-Provided Connecting Cable Will Be Terminated In Connectors With A Designation Of "P1" And "P2" But Will Have The Identical Pin-Out As Shown In This Table.

Note 5: These services are no longer available/offered.

## Hitchhiker Standard Interface Cables (Canister Customer)



**Note:**  
X = Customer port number (To Be Assigned By HH Project)  
Note 1 on Figure  
2.32 applies in full to this drawing

FIGURE 2.35 HITCHHIKER STANDARD INTERFACE CABLES

## Hitchhiker Motorized Door Canister Control and Monitoring Interface

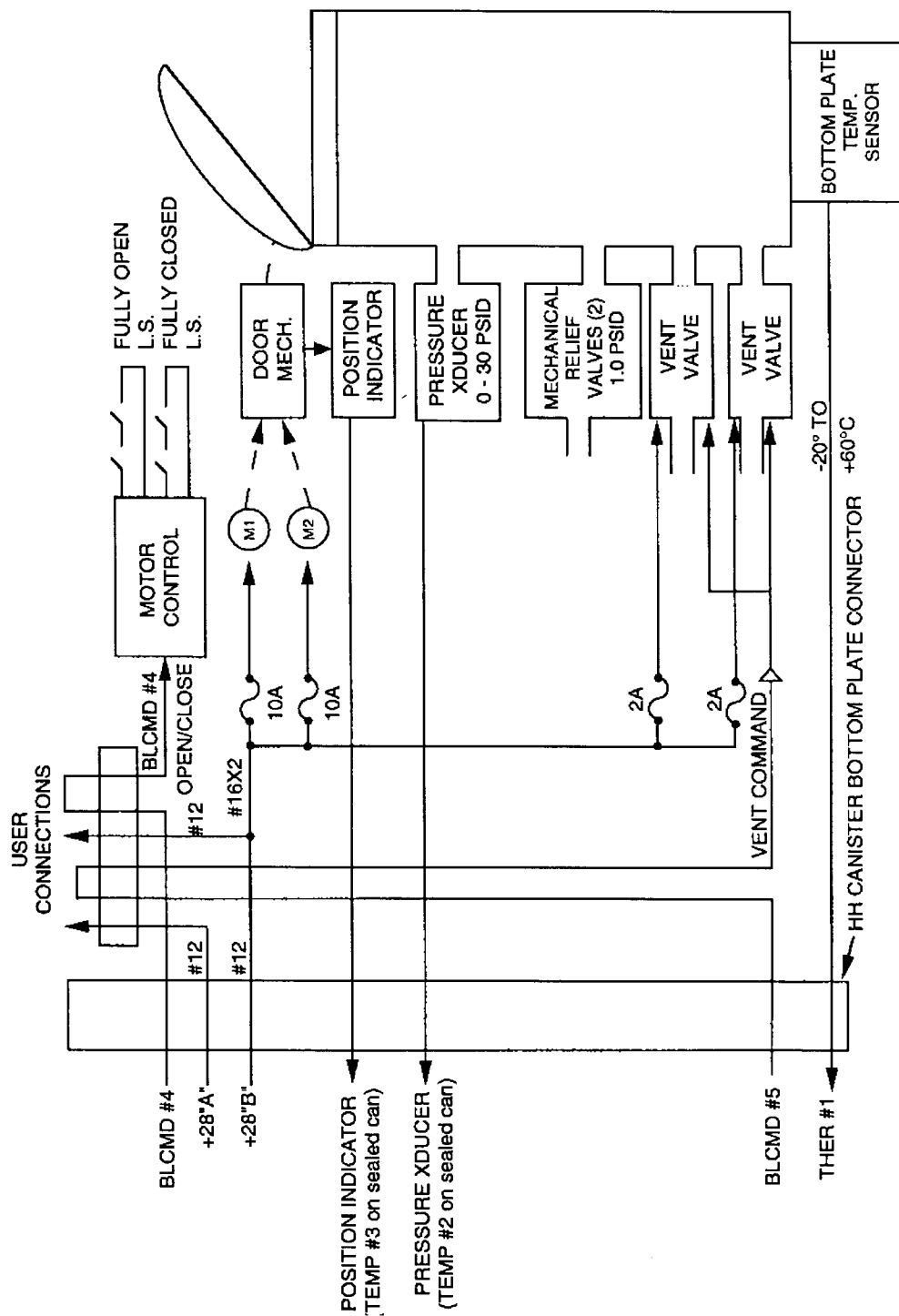


FIGURE 2.36 HITCHHIKER MOTORIZED DOOR CANISTER

TABLE 2.5 CANISTER ELECTRICAL INTERFACE CONNECTORS

| <b>ID</b>                                  | <b>Pin(Note 3)</b> | <b>Type(Note 2)</b> | <b>Function</b>                          |
|--|--------------------|---------------------|--|
| <b><u>Power Connector P1:</u></b>          |                    |                     |  |
| +28A                                       | A                  | C                   | +28V Power Circuit A                     |
| RETA                                       | B                  | C                   | Power Return (Note 1)                    |
| +28B                                       | C                  | C                   | +28V Power Circuit B (Note 5)            |
| RETB                                       | D                  | C                   | Power Return (Note 1)                    |
| +28HTR                                     | E                  | B                   | + 28V Heater Power                       |
| RETH                                       | F                  | B                   | Heater Power Return (Note 1)             |
| FRMGND                                     | G                  | B                   | Frame Ground                             |
| <b><u>Signal Connector P2:(Note 4)</u></b> |                    |                     |  |
| PCMAD                                      | 1                  | A                   | PCM Analog Data                          |
| PCMINDX                                    | 41                 | A                   | PCM Index Pulse                          |
| SIGGND                                     | 2                  | A                   | Signal Ground                            |
| PCMCLK                                     | 42                 | A                   | PCM Bit Rate Clock (Note 11)             |
| PCMENA                                     | 32                 | A                   | Serial Digital Enable A (Note 11)        |
| PCMENB                                     | 33                 | A                   | Serial Digital Enable B (Note 11)        |
| PCMDATA                                    | 3                  | A                   | Serial Digital Data A (Note 11)          |
| PCMDATB                                    | 8                  | A                   | Serial Digital Data B (Note 11)          |
| THER1                                      | 14                 | A                   | Thermistor 1 (Not Wired To PLD) (Note 6) |
| THER2                                      | 15                 | A                   | Canister Pressure (Not Wired To PLD)     |
| THER3                                      | 16                 | A                   | MDA Door Position 0-5 V (Note 7)         |
| SHIELD                                     | 6                  | A                   | Shield For Command And Data Signals      |
| RD+  | 21                 | A                   | Receive Data Async + From SPOC           |
| RD-  | 22                 | A                   | Receive Data Async - From SPOC           |
| SD+  | 23                 | A                   | Send Data Async + To SPOC                |
| SD-  | 24                 | A                   | Send Data Async - To SPOC                |
| BLCMD1                                     | 17                 | A                   | Bi-level/Pulse Command 1                 |
| BLCMD2                                     | 18                 | A                   | Bi-level/Pulse Command 2                 |
| BLCMD3                                     | 19                 | A                   | Bi-Level/Pulse Command 3                 |
| BLCMD4                                     | 20                 | A                   | Bi-level Cmd 4/Open Close MDALID         |
| SCMDCLK                                    | 10                 | A                   | Serial Command Clock (Note 11)           |
| SCMDENV                                    | 11                 | A                   | Serial Command Envelope (Note 11)        |
| SCMDDAT                                    | 12                 | A                   | Serial Command Data (Note 11)            |
| GMTMIN                                     | 40                 | A                   | GMT/MET One-Minute Pulse                 |
| IRIGGMT+                                   | 30                 | A                   | IRIG-B GMT (MET) +                       |
| IRIGGMT-                                   | 31                 | A                   | IRIG-B GMT (MET)-                        |
| FRMGND                                     | 49                 | A                   | FRAME GROUND                             |
| KUMRCLK+                                   | 34                 | A                   | Customer-Generated MR Clock +            |
| KUMRCLK-                                   | 35                 | A                   | MR Clock -                               |
| KUMRDAT+                                   | 43                 | A                   | Customer-Generated MR Data +             |
| KUMRDAT-                                   | 44                 | A                   | MR Data -                                |
| KUMRSHLD                                   | 25                 | A                   | Shield For Ku Signals                    |
| UNDTSP1+                                   | 61                 | D                   | Undedicated TSP 1 + (Optional Video +)   |
| UNDTSP1-                                   | 66                 | D                   | Undedicated TSP 1 - (Optional Video -)   |
| UNDTSPS1                                   | 54                 | A                   | Shield For Undedicated TSP 1             |
| UNDTSP2+                                   | 62                 | D                   | Undedicated TSP 2 +                      |
| UNDTSP2-                                   | 63                 | D                   | Undedicated TSP -                        |
| UNDTSPS2                                   | 55                 | A                   | Shield For Undedicated TSP 2             |

TABLE 2.5 CONTINUED

| <b><u>ID</u></b> | <b><u>Pin</u></b> (Note 3) | <b><u>Type</u></b> (Note 2) | <b><u>Function</u></b>                          |
|------------------|----------------------------|-----------------------------|---|
| UNDTSP3+         | 56                         | A                           | Undedicated TSP 3+                              |
| UNDTSP3-         | 57                         | A                           | Undedicated TSP 3-                              |
| UNDTSPS3         | 48                         | A                           | Shield For Undedicated TSP 3                    |
| UND4             | 58                         | A                           | Undedicated 4                                   |
| UND5             | 59                         | A                           | Undedicated 5                                   |
| UND6             | 60                         | A                           | Undedicated 6                                   |
| UND7             | 64                         | A                           | Undedicated 7                                   |
| UND8             | 65                         | A                           | Undedicated 8                                   |
| UNDS             | 53                         | A                           | Shield For Undedicated 4-8                      |
| MDAOC            | 52                         | A                           | MDA Door Open/Close SIG To MDA                  |
| SW-6 NO          | 26                         | E                           | MDA Door Open Switch S6, Normally Open (Note 9) |
| SW-6 C           | 27                         | E                           | MDA Door Open Switch S6, Center Contact         |
| SW-6 NC          | 28                         | E                           | MDA Door Open Switch S6, Normally Closed        |
| SW-5 NO          | 36                         | E                           | MDA Door Open Switch S5, Normally Open          |
| SW-5 C           | 37                         | E                           | MDA Door Open Switch S5, Center Contact         |
| SW-5 NC          | 38                         | E                           | MDA Door Open Switch S5, Normally Closed        |

**Safe/Arm Connector P3: (Note 10)**

|                  |   |   |     |
|------------------|---|---|-----|
| PYRO 1 PWR       | A | B | --- |
| PYRO 1 RET       | B | B | --- |
| PYRO 1 PWR (DEV) | G | B | --- |
| PYRO 1 RET (DEV) | R | B | --- |
| PYRO 2 PWR       | N | B | --- |
| PYRO 2 RET       | C | B | --- |
| PYRO 2 PWR (DEV) | J | B | --- |
| PYRO 2 RET (DEV) | H | B | --- |
| PYRO 3 PWR       | P | B | --- |
| PYRO 3 RET       | D | B | --- |
| PYRO 3 PWR (DEV) | L | B | --- |
| PYRO 3 RET (DEV) | K | B | --- |
| PYRO 4 PWR       | F | B | --- |
| PYRO 4 RET       | E | B | --- |
| PYRO 4 PWR (DEV) | M | B | --- |
| PYRO 4 RTN (DEV) | S | B | --- |

Note 1: Power Return Pins B, D, And F May Be Connected Together Within Payload

Note 2: Wire Type Designation:

|   |       |
|---|-------|
| A | 22 GA |
| B | 16 GA |
| C | 12 GA |
| D | 26 GA |
| E | 24 GA |
| F | 20 GA |

TABLE 2.5 CONTINUED

|          |  |
|----------|--|
| Note 3:  | Customer will make no connections to unused pins   |
| Note 4:  | The designations "P1" and "P2" in this table indicate the pin-out for a cable-mounted connector. A canister experiment would need this termination to interface to the canister baseplate connector (designated as "J1" and "J2"). The pinouts are identical for either "J" or "P" designated connectors. Connector pair J3/P3 is a safe and arm connector whose use is not a standard service. The pin-out is not included. |
| Note 5:  | 28v b power circuit shared with MDA motors - may contain excess EMI during door motor operation.   |
| Note 6:  | Thermistor 1 is located on canister bottom plate   |
| Note 7:  | Pin 16 (MDA door position) may only be connected to high-resistance (100 k ohms) load within payload if MDA is flown   |
| Note 8:  | pin 20 BLCMD 4 to be connected to pin 52 (MDA open/close control) unless payload has other provision for generating 28v 10MA signal to open door (if MDA is flown).  |
| Note 9:  | When door is fully opened, normally open contact is shorted to center contact.<br>When door is closed, normally closed contact is shorted to center contact.   |
| Note 10: | Safe/arm connector is currently configured as a feed through, from outside Canister to experiment.   |
| Note 11: | These services are no longer offered.  |

TABLE 2.6 CIRCUIT PROTECTION REQUIREMENTS

| Min. Wire Gauge | Max. Fuse Size (A) | Max. Load (A) |
|-----------------|--------------------|---------------|
| 26              | 3                  | 1.5           |
| 24              | 5                  | 2.5           |
| 22              | 6                  | 3.0           |
| 20              | 7.5                | 3.75          |
| 18              | 10                 | 5.0           |
| 16              | 12.5               | 6.25          |
| 14              | 15                 | 7.5           |
| 12              | 25                 | 12.5          |
| 10              | 30                 | 15            |

Six electrical interfaces are provided via six standard sets of cables and connectors. Two additional sets are reserved for system use. These provide up to 500W of 28VDC power to each interface and 50W of "Survival Heater Power." In addition to providing this type of interface during on-orbit operations, the HH has provisions for a transparent bi-directional data path between the customer's payload and the Customer Ground Support Equipment (CGSE). This type of interface allows the customer to maintain autonomous control over his/her payload.

The characteristics of the power will be the same as Orbiter power except for higher source resistance due to the added carrier wiring. It is important to note that, while power is switched to each experiment through the HH avionics, no EMI filtering is provided. Customers will see the EMI environment specified in Appendix H and are expected to meet all EMI requirements by providing filtering with each experiment. Each power interface will consist of 28 VDC +/- 4 VDC power supplied via dual 12 gauge 10A circuits. Each of the dual circuits can be switched in through independent contacts of a Double-Pole Single Throw (DPST) relay (Figure 2.38). Each power interface will have independent current measurement capability.

### 2.3.3 DC Power Ripple and Transient Limits (For Payload Main Circuit Only)

See Appendix H of this document.

TABLE 2.7 CUSTOMER ELECTRICAL INTERFACES AND SERVICE SUMMARY

1. 28 VDC (+/- 4 VDC) Power (Dual 10A Circuits)
2. Asynchronous Interface (Bi-Directional, 1200 Baud)
3. Serial Command (Clock/Data/Envelope) can also function as Individual Bi-Level 0, +5v Commands (3 Each)
4. Bi-Level or Pulse 0, +28v Command (4 Each)
5. IRIG-B Met and Met One-Minute Pulse
6. Medium-Rate Ku-Band Data (16 Kb - 1.4 Mb/S Total, Clock/Data Interface)

Items 2, 3, 4, and 6 can be interfaced to customer GSE

Items 2 and 6 are "Transparent" interfaces

TABLE 2.8 HITCHHIKER ELECTRICAL ACCOMMODATIONS

|                         | Total HH and<br>Customer Payloads<br>Max | Single Customer Payload Port<br>Max |
|-------------------------|--|-------------------------------------|
| Power (28 +/- 4DC)      | 1300W                                    | 500w                                |
| Energy (KWH)            | 60                                       | 10 (Note 2)                         |
| Low-Rate Downlink       | 6000 B/S                                 | 960 B/S (Note 1)                    |
| Medium-Rate Downlink    | 1.4 Mb/S                                 | 1.4 Mb/S (Note 3)                   |
| Serial Command Channels | 6  | 1 (Note 4)                          |
| Bi-Level Commands       | 24                                       | 4                                   |

Note 1: Nominal Information Rate Of One Standard Asynchronous Channel. Any Combination Of Five 1.2k Baud Channels May Be Downlinked Simultaneously.

Note 2: Nominal 1/6 Allocation.

Note 3: By Mission Requirements.

Note 4: These Services Are No Longer Offered.

## Customer Power Interface

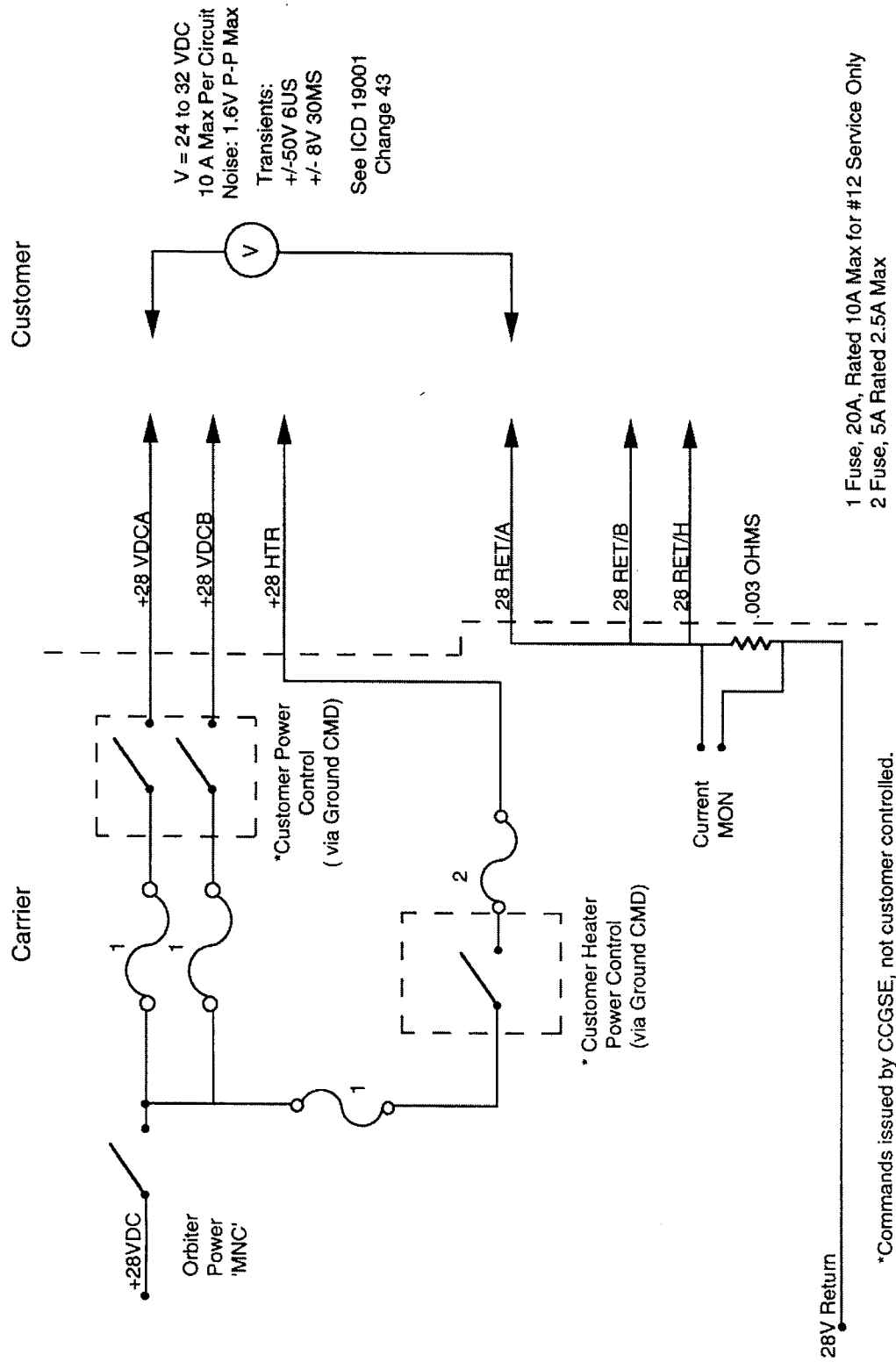


FIGURE 2.37 CUSTOMER POWER INTERFACE

In addition to the two 10-amp power lines, one 2.5-amp heater line is available at each power port. Heater service is controlled via a single relay for multiple customer ports. Therefore, power to this line shall be assumed ON for the duration of the flight. It is recommended that customers included internal (e.g., thermostatic) switching for this service.

## Hitchhiker Avionics Unit - Power Distribution

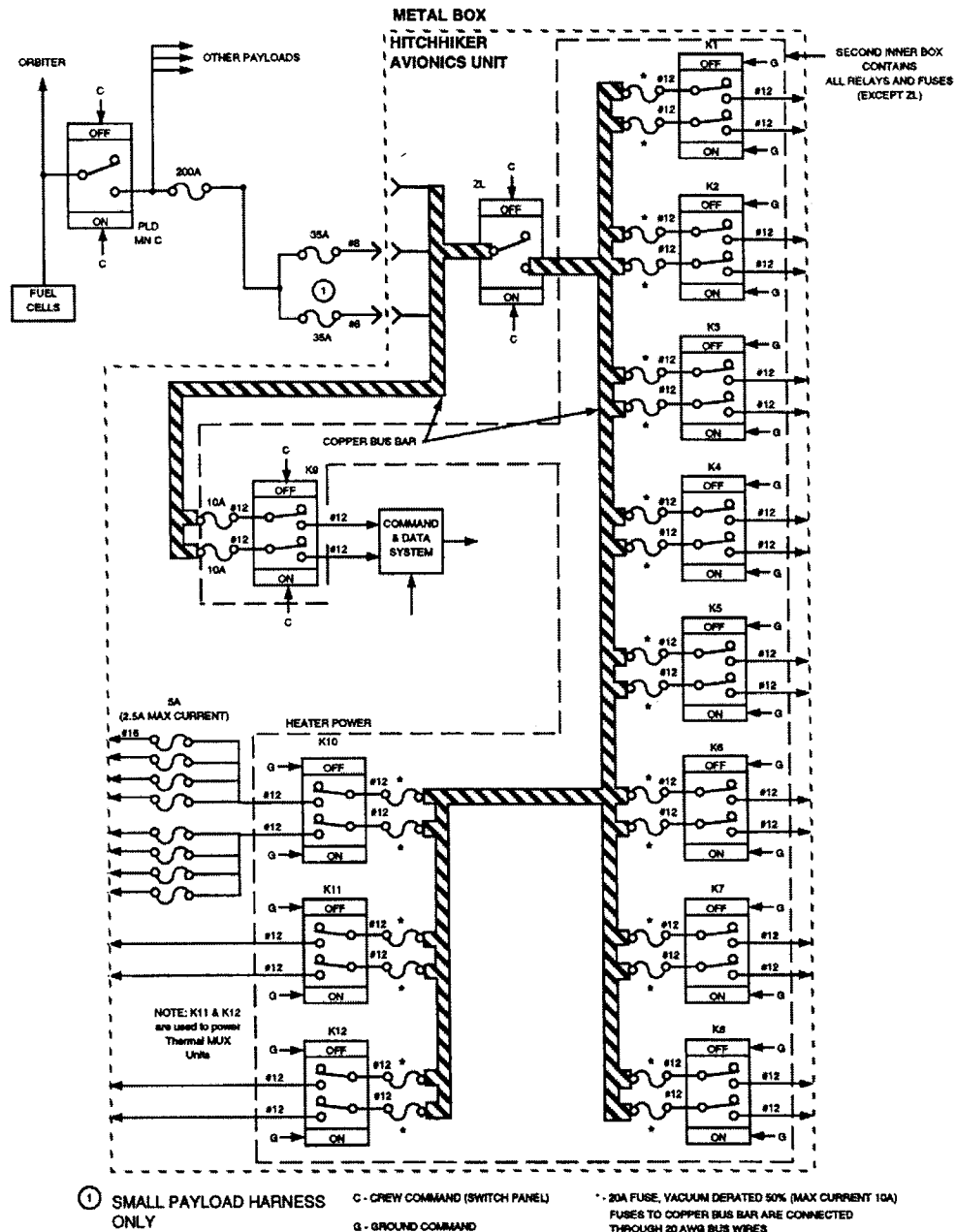


FIGURE 2.38 HITCHHIKER AVIONICS UNIT – POWER DISTRIBUTION

### **2.3.4 Thermal Power Characteristics**

The thermistor characteristics that accomplish thermal control are specified in section 2.2.6.

### **2.3.5 Signal Characteristics**

This data is available to the customer either in real-time or post-flight when specified as a requirement. Figure 2.40 provides a schematic drawing of the HH-S customer power interface. Customer signal ground must be connected to chassis (case). As shown in Figure 2.48, 28v return must be used for the bi-level return. The customer 28v return must be isolated from both signal ground and chassis (case) by a minimum resistance of 1M ohm. This requirement cannot be waived.

Tables 2.7 and 2.8 provide the detailed characteristics of the electrical system interfaces. A switch panel is used for carrier and experiment power activation and de-activation and may be used to provide a safety inhibit to a customer's hazardous function if required.

### **2.3.6 Standard Connectors for Customers**

In choosing connectors for experiment internal wiring harnesses, it is highly recommended that the selection be limited to the MIL-C-38999 series I, II, or III or other space flight approved connectors. In the cases where GSFC is to supply the cables and harnesses as a service to the customer or where the connectors are otherwise specified within this document, the selection of connectors must be made from MIL-C-38999 to minimize cost and schedule impacts. GSFC will not be responsible for supplying connectors outside this specification. Sources of supply are as follows:

ITT Cannon  
666 E. Dyer Road  
P.O. Box 929  
Santa Ana, CA 92702-0929

Amphenol Corporation  
Bendix Connector Operations  
40-60 Delaware Avenue  
Sidney, NY 13838-1395

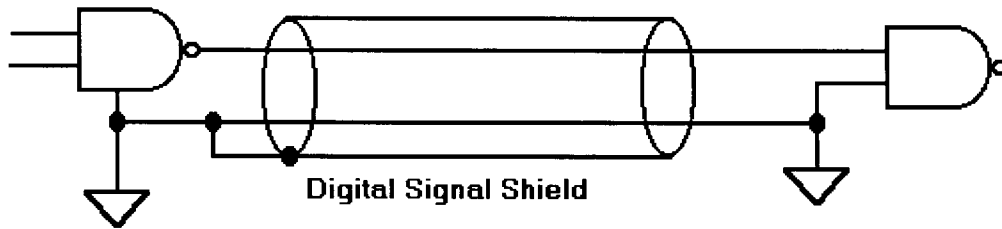
Matrix Sciences  
365 Maple Avenue  
Torrence, CA 90503

A detailed specification for this series of connectors may be obtained through the GSFC library or through the GSFC Code 300 library. Specific information regarding the manufacturer part numbering, cost, availability, etc. may be obtained from the above sources or through the GSFC electrical engineer assigned to the project.

### **2.3.7 Shield Grounding**

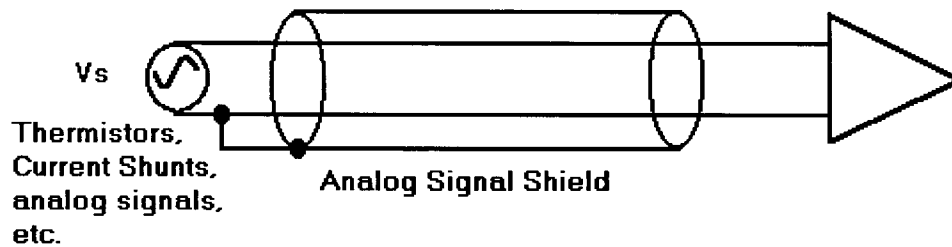
In order to maintain the EMC of the Hitchhiker and its customer, the following shielding practices will be used.

Refer to Figure 2.40. All logic level signals and analog signals excluding video and RF shall have their shields grounded to the signal ground at the sending end only. Signal returns will be routed in the same bundle as the associated signal lines in order to minimize electromagnetic emission and susceptibility.



a. Logic Level signal shield practice

FIGURE 2.39 DIGITAL SIGNAL SHIELD



b. Analog shielding practice

FIGURE 2.40 SHIELD GROUNDING OF LOGIC LEVEL AND ANALOG SIGNALS

All lines which carry significant current transitions while displaying “clean” constant voltages will be electromagnetically shielded (both ends grounded). Typically this will occur on power lines and the shields shall be grounded to chassis in these cases. Power distribution shall be through twisted pairs of wires in bundles separate from other signals. Refer to Figure 2.41.

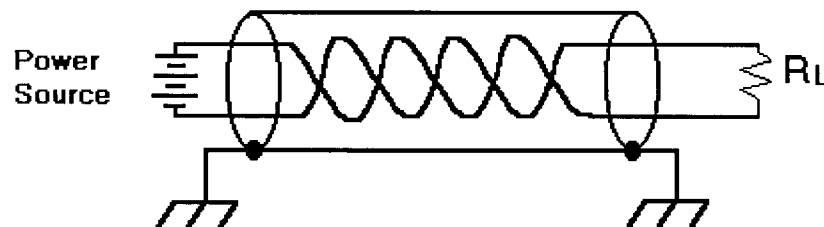


FIGURE 2.41 SHIELD GROUNDING OF POWER LINE

All lines which carry significant current and voltage transitions will be double shielded with an electrostatic shield (sending end grounded) and an electromagnetic shield (both ends grounded to chassis). Refer to Figure 2.42. This will occur on relay drive signals typically.

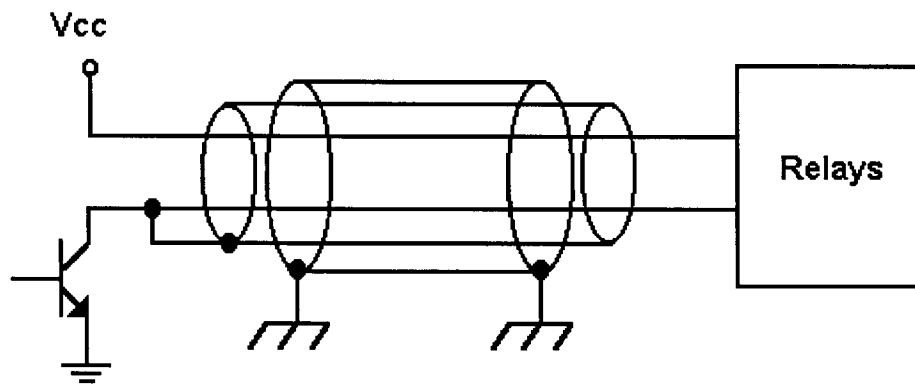


FIGURE 2.42 DOUBLE SHIELDING SIGNIFICANTLY VARYING CURRENT AND VOLTAGE LINES